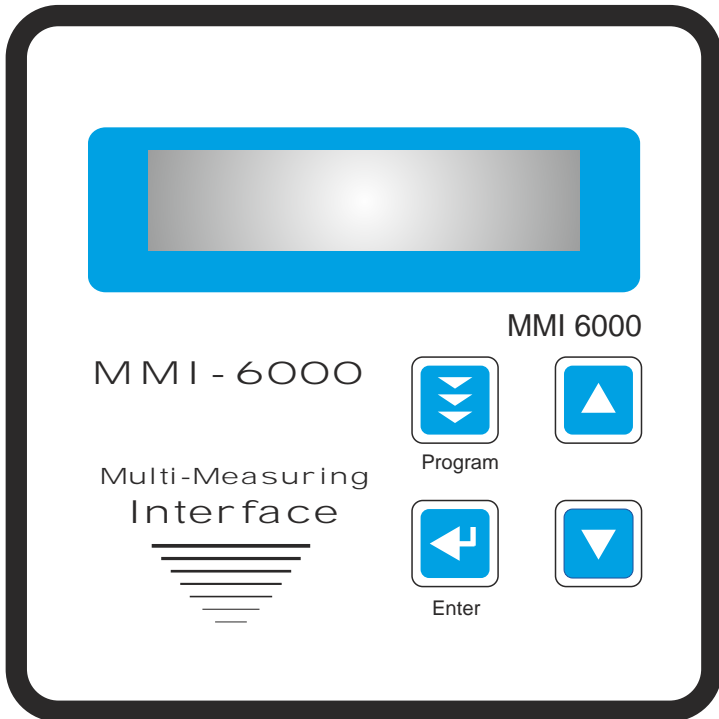


Multi-Measuring-Interface  
MMI 6000



Manual of operation

V 8.0 E



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## Section 1: General remarks

The Multi-Measuring-Interface MMI6000 provides a variety of services combined in a single device. It can be operated as an accessory of the power factor controller but also as a stand-alone measuring device. Employed as accessory, the coupling to the controller is easily realized via the integrated RS485 interface.

The following modes of operation can be chosen for the MMI 6000:

- **DYNA-I - TRIGGER**

The MMI6000 operates independently as an automatic trigger for dynamic thyristor switches. Such a trigger is required by applications with fast changing loads, where an instantaneous (real-time) reaction is necessary. Applications for example, that call for the very fast switching in of a single, large step and for which the application itself does not provide a suitable trigger signal (e.g. welding machinery, flicker compensation). Dynamic power factor correction controllers are simply not fast enough for such applications. The MMI6000 is. It provides the trigger signal within 1 ms. Needless to say that the optocoupler output type is required to make use of this mode of operation.

- **Coupling MMI 6000 - BR6000-T (dynamic controller)**

The main application is again the real monitoring of the current in power factor correction installations. In this mode the MMI6000 is employed for a real-time control of the dynamic, thyristor switched steps.

- **Coupling MMI 6000 - BR6000 (via interface RS 485)**

In this mode the MMI6000 is used for real current measurement (e.g. measurement of the current inside the power factor correction (PFC) installation). By an intelligent comparison of the measured PFC installation current with the respectively active capacitors, the actual currents of single capacitors can be monitored (protection of capacitors and the whole PFC installation)

- **Coupling MMI 6000 - BR7003-R:** function as above

- **Coupling MMI 6000 - BR7001-R:** function as above

- **MMI 6000 - MODBUS RTU** (factory setting)

In this mode the MMI 6000 is utilization as a separate measuring device. Multiple grid parameters (voltage, current, active power, reactive power, apparent power, cos-phi, frequency, temperature) are measured and provided via MODBUS RTU protocol (e.g. further processing by PLC - application of multiple MMI6000 by separate addressing possible). In this mode of operation the MMI6000 can also be used as a comfortable trigger relay for various measuring quantities as for example current, cos-phi, temperature or energy.

- **MMI 6000 - ASCII-OUT**

In this mode the mentioned measured parameters are provided in ASCII code via interface. In this mode MMI6000 can be used as trigger-relay also.

The MMI6000 can easily be configured for the particular application via its 4 buttons and the display. Standard languages for all menus are German and English.

The output relay can, with respect to the individual application be configured as optocoupler or as standard relay.

## Section 2: Technical specifications

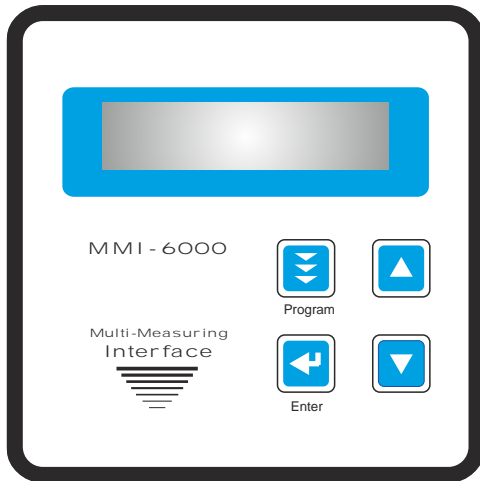
|   |  |
|---|--|
| Types   | MMI 6000<br>MMI 6000-R (relay-output)<br>MMI 6000-T (optocoupler)  |
| Output (depends on types)                     | 1x interface RS 485, max. 32 user relay or optocoupler output  |
| Display                                       | Illuminated graphical display 2 x 16 characters  |
| Modes of operation<br>(menu: „configuration“) | DYNA-I-TRIGGER<br>Coupling MMI - BR6000-T<br>Coupling MMI - BR6000-R<br>Coupling MMI - BR7003-R<br>Coupling MMI - BR7001-R<br>MMI - MODBUS RTU (Preset)<br>MMI - ASCII OUT |
| Measurement categories                        | Voltage, current, power factor active-, reactive-, apparent power frequency, temperature, energy   |
| Saving of max. values (menu „service“)        | min/max voltage, max. current max. active-, reactive-, apparent power, max. temperature  |
| Languages                                     | German / English   |
| Supply and measurement voltage                | 230V, 50/60 Hz   |
| Power consumption                             | < 4VA  |
| Measurement current                           | X/5A and X/1A  |
| Output capacity                               | Optocoupler: 60 VDC, 150 mA<br>Standard relay: 250VAC, 1000W   |
| Meas. temperature range                       | 0 ... 100°C  |
| Housing                                       | Switchboard installation housing<br>DIN 43 700, 100 x 100 x 55 mm  |

### Section 3: Installation of MMI 6000

The MMI 6000 is constructed for a supply and measurement voltage of 230 VAC, 50/60 Hz, and a measurement current of 5 A or 1 A (programmable). It is designed for front side integration in switching cabinets. Mounting parts for a DIN-standard bar are optionally available.

The MMI 6000 has to be operated by qualified staff only and has to be operated according to the mandatory safety regulations.

Prior to connection all lines have to be tested to ensure their zero-potential. The current transformer has to be shorted-out. The correct phasing of voltage and measured current has to be respected. The current measurement circuit has to be connected by 2.5 sqmm Cu wires. It is very important to keep to the required safety measured accordingly. After the connection the MMI 6000 is ready for operation without any delay.



- Program:
- Display mode
  - Programming
  - Service
  - Expert mode



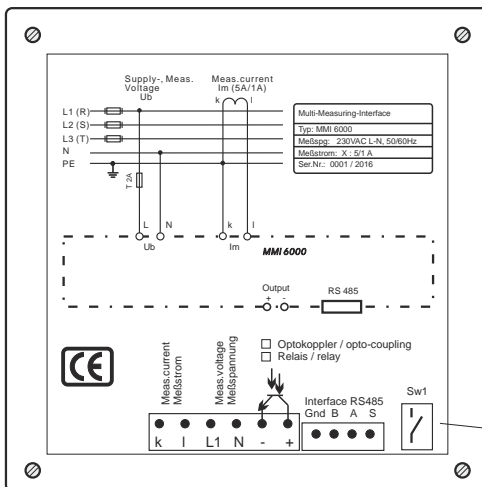
- ENTER  
Confirmation and save of entered value



- Increase of chosen parameter



- Decrease of chosen parameter



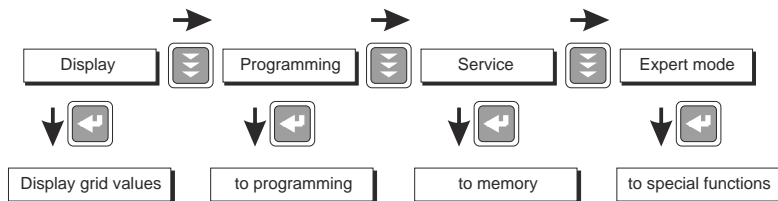
Back side MMI 6000

Connection of MMI 6000 according to adjoining connection diagram

Switch for terminating resistor

## Section 4: General operation references

By repeated pressing of the button "Program" the different menus are reached one after the other: Display, Programming, Service, Expert mode and back again.



By pressing the button "Program" once the display mode is left and the programming mode is entered. The display always shows the parameter of interest in the first line and the editable value in the second line. Changeable values are always shown inside of square brackets [ ]. The actual change of a value is done using the buttons  $\uparrow$  /  $\downarrow$ . By pressing the button "Enter" an adjusted value is saved/confirmed and the next parameter is displayed. The programming mode can be left during all steps by pressing "Program" again.

### 4.1 Setting mode of operation (programming)

Entering the programming mode the first step is to choose the language (confirm by "Enter"). As second step the transmission ratio of the current transformer (primary and secondary current) has to be entered. Subsequently the mode of operation of the MMI6000 can be selected with respect to the present application.

- (1) DYNA-I-TRIGGER (version -T only)
- (2) Coupling MMI - BR6000-T
- (3) Coupling MMI - BR6000-R
- (4) Coupling MMI - BR7003-R
- (5) Coupling MMI - BR7001-R
- (6) MMI - MODBUS RTU (Preset)
- (7) ASCII-OUT

Depending on the chosen mode of operation the software menu is adapted and thus not completely the same for all modes of operation. Due to this the different modes of operation are explained on the next several pages.

### 4.2 Service menu

The display of the service menu depends on the chosen mode of operation. Using it, maximal values of voltage, current, active power, reactive power, apparent power, temperature, the minimal voltage, and the accumulated energy can be accessed. The time of integration for the maximal values is 1 second.

## Section 5: Mode of operation Dyna-I-Trigger (MMI 6000-T only)

Purpose: Dynamic current trigger

The MMI6000 operates independently as an automatic trigger for dynamic thyristor switches. Such a trigger is required for applications with fast changing loads, where an instantaneous (real-time) reaction is necessary. Applications for example that call for very fast switching in of a single, large step and for which the application itself does not provide a suitable trigger signal (e.g. welding machinery, flicker compensation).

Dynamic power factor correction controllers are simply not fast enough for such applications. The MMI6000 is. The MMI6000 features a novel measurement principle and is able to provide a switching signal within 1 ms. Making use of this ultra-fast measurement in combination with the internal optocoupler interface, dynamic thyristor switches can be controlled directly and without delay.

The measurement itself is carried out using a standard current transformer X: 5/1A.

Display:

The status of the output is displayed as follows:

L = output OFF

H = output ON,

P = output pulsing (pulse output) refer to description of "hold time"

Programming of MMI 6000 (setting of operation mode in programming)

3 Configuration [DYNA-I TRIGGER]

10 Trigger ON [600]A (possible: 5 ... 990A)  
Setting of the switching on threshold - compare appendix 2

11 Trigger OFF [400]A (possible: 5 ... 990A)  
Setting of the switching off threshold - compare appendix 2

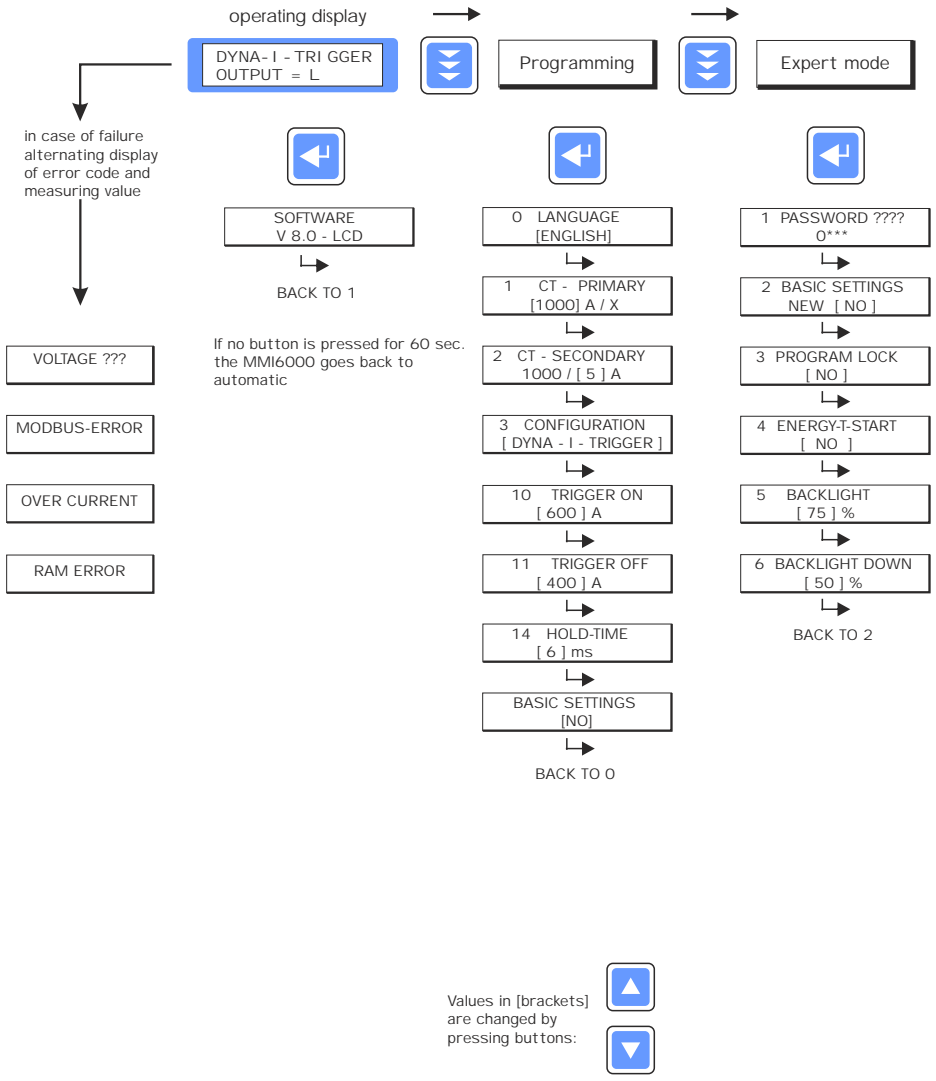
14 Hold time [6] ms (0 ... 255)  
The pulsed trigger signal is produced in real time. If a stable, static signal is necessary for further processing, it can be generated by introducing a hold time [ms] (for bypassing the zero-crossing).

Basic settings [NO] ( alternative: YES)

Choosing YES and confirming (Enter) resets all values to the factory settings.



# Mode of operation: Dyna-I-Trigger



## Section 6: Mode of operation. Coupling MMI 6000 - BR6000-T (dynamic)

Purpose:

Coupling of a MMI6000 with a BR6000-T (dynamic) power factor controller (via RS485 interface)

In this mode of operation the MMI6000 is used as an additional measurement device for the BR6000. The intention is to measure the real current of a dynamic PFC installation. That means also an additional current transformer, installed at the input to the power factor correction setup is necessary. By an intelligent comparison of the measured installation current with the respectively active capacitors, the actual currents of single capacitors can be monitored (protection of capacitors and the whole PFC installation). The installation current is displayed at the BR6000-T in the display mode menu item "11 COMP. POWER".

Employing this mode of operation the capacitors, thyristor switches, and fuses are monitored simultaneously. In case of a failure (under current caused by disconnected fuses or a defect capacitor / over current caused by a capacitor problem / etc.) the associated error codes are shown at the display of the BR6000-T and assigned to the respective capacitor branch.

Programming of the BR6000-T

For the coupling to a MMI6000 the power factor controller BR6000 the following adjustments have to be made:

Expert mode: "19 PROTOCOL" set to MODBUS master

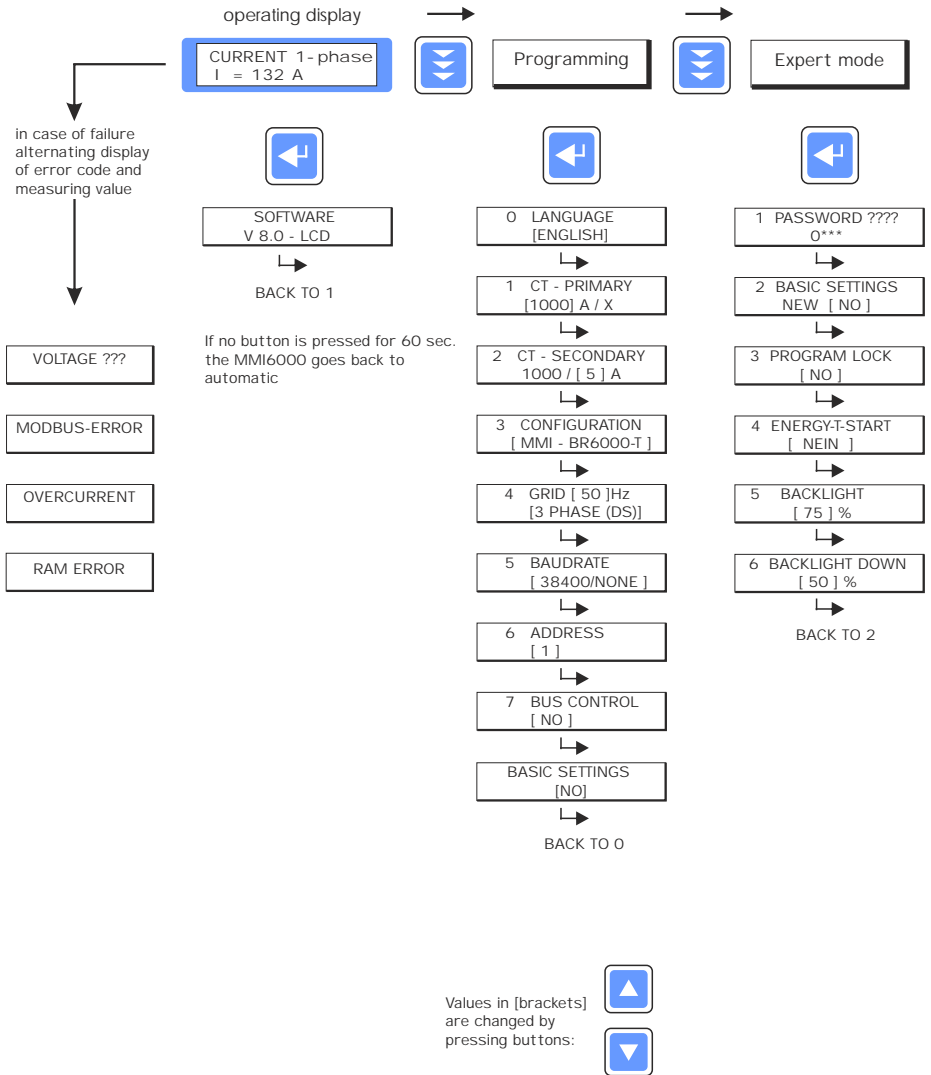
Programming mode: "18 LIMIT VALUE"

choose shutdown threshold (factory setting 130%, possible: 110 ... 200%)

Programming of MMI 6000 (setting of operation mode in programming)

- 3 Configuration [MMI-BR6000-T]
  - 4 Grid [3-phase (DS)] (alternative: 1-phase (WS))  
Standard is to measure using a single current transformer (display is 3-phase assuming grid symmetry). For real single-phase displaying [1-phase (WS)] has to be set. In this case currents and powers are referred to the particular phase.
  - 5 BAUDRATE [38400 NONE] (9600...256000) NONE/ODD/EVEN  
RS485 interface baud rate.
  - 6 ADDRESS [1] (possible 1 ... 255)  
Address range to allow the use of several MMI6000 at the same bus.
  - 7 Bus control [NO] (alternative: YES)  
Control of communication. A possible bus error will be display if activated.
- Basic settings [NO] (alternative: YES)  
Choosing YES and confirming (Enter)  
resets all values to the factory settings.

# Mode of operation MMI - BR 6000-T (dynamic)



Section 7: Mode of operation: Coupling MMI - BR6000-R  
MMI - BR7003-R  
MMI - BR7001-R

**Purpose:**

Coupling of a MMI6000 with a p.f.controller (via RS485 interface)

In this mode of operation the MMI6000 is utilized as an additional measurement device to the controller. The intention is to measure the real current of the power factor correction installation. That means also an additional current transformer, installed at the input to the power factor correction setup is necessary. By an intelligent comparison of the measured installation current with the respectively active capacitors, the actual currents of single capacitors can be monitored (protection of capacitors and the whole PFC installation). The PFC current is displayed at the controller selecting the display mode menu item "COMP.POWER".

Upon reaching the shutdown threshold "installation limit" that can be set, the controller switches of the single correction steps one after the other according to the set control series until the current falls below the set threshold value. The following error codes can be displayed at the controllers display if connected to a MMI6000:

- CURRENT > ?
- CURRENT < ?
- OVERLOAD EQUIP. (controller switches off automatically)
- C DEFECT (during C-tests only)

**Programming at the P.F.Controller**

BR 6000: in expert mode / protocol

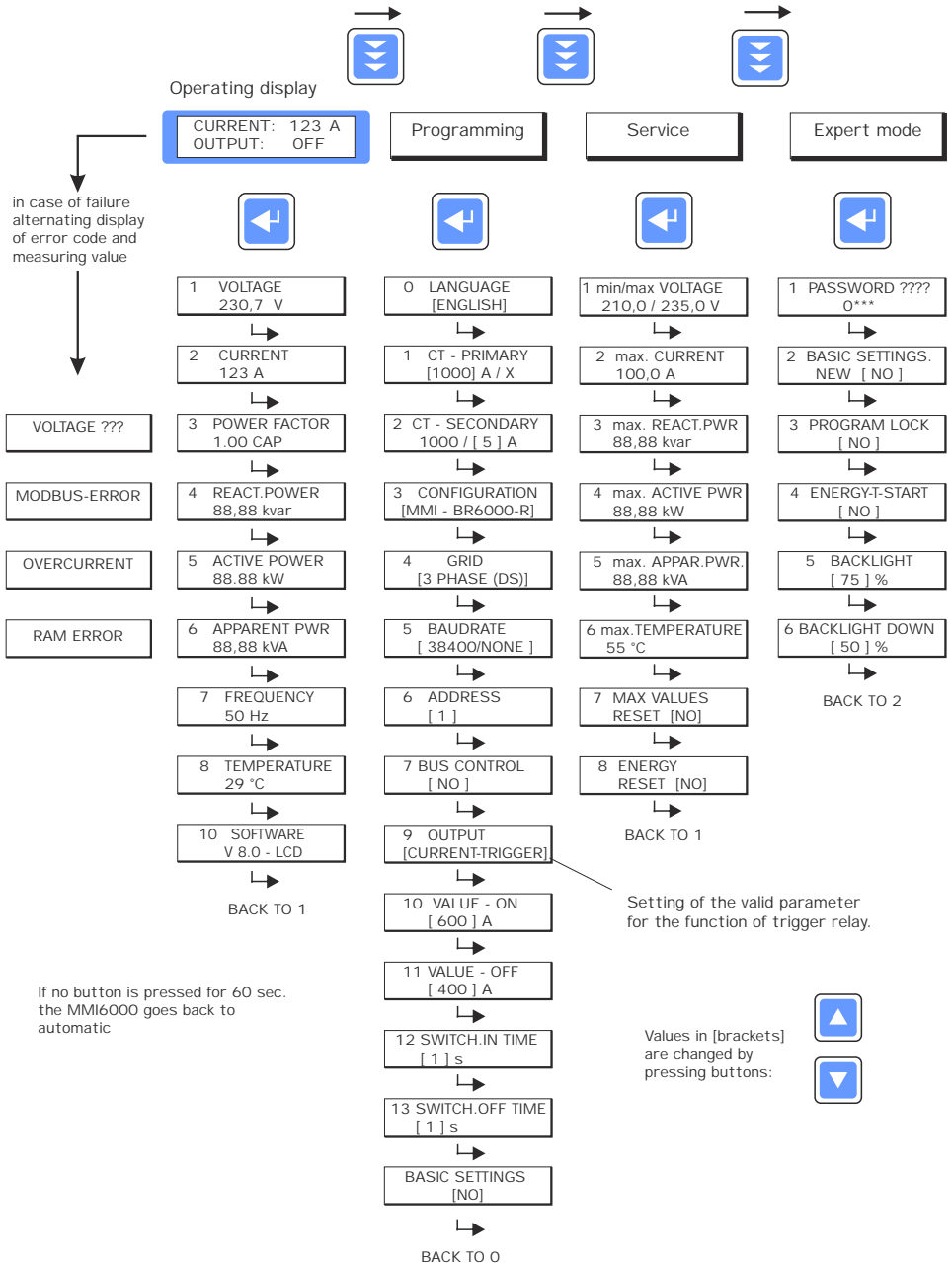
BR 7001: in interface-mode / protocol

BR 7003: in programming / control mode

**Programming of MMI 6000 (setting of operation mode in programming)**

- 3 Configuration [MMI - BR6000-R] (BR7003-R / BR7001-R)
  - 4 Grid [3-phase (DS)] (alternative: 1-phase (WS))  
It is standard to measure using a single current transformer (display is 3-phase assuming grid symmetry). For real single-phase displaying [1-phase (WS)] has to be set. In this case currents and powers are referred to the particular phase.
  - 5 BAUDRATE [38400/NONE] (9600...256000) NONE/ODD/EVEN  
RS485 interface baudrate.
  - 6 ADDRESS [1] (possible: 1...255)  
Address range to allow the use of several MMI6000 at the same bus.
  - 7 Bus control [NO] (alternative YES)  
Control of communication. A possible bus error will be display if activated.
- 9 - ff For explanation please refer to page 13
- Basic settings [NO] (alternative: YES)  
Choosing YES and confirming (Enter) resets all values to the factory settings.

# Mode of operation MMI - BR 6000-R MMI - BR 7003-R MMI - BR 7001-R



Section 8: Mode of operation: MMI - MODBUS RTU (MMI as measuring device)  
and MMI as Trigger-relay (Factory setting)

Purpose:

MMI6000 as separate measuring device and trigger relay

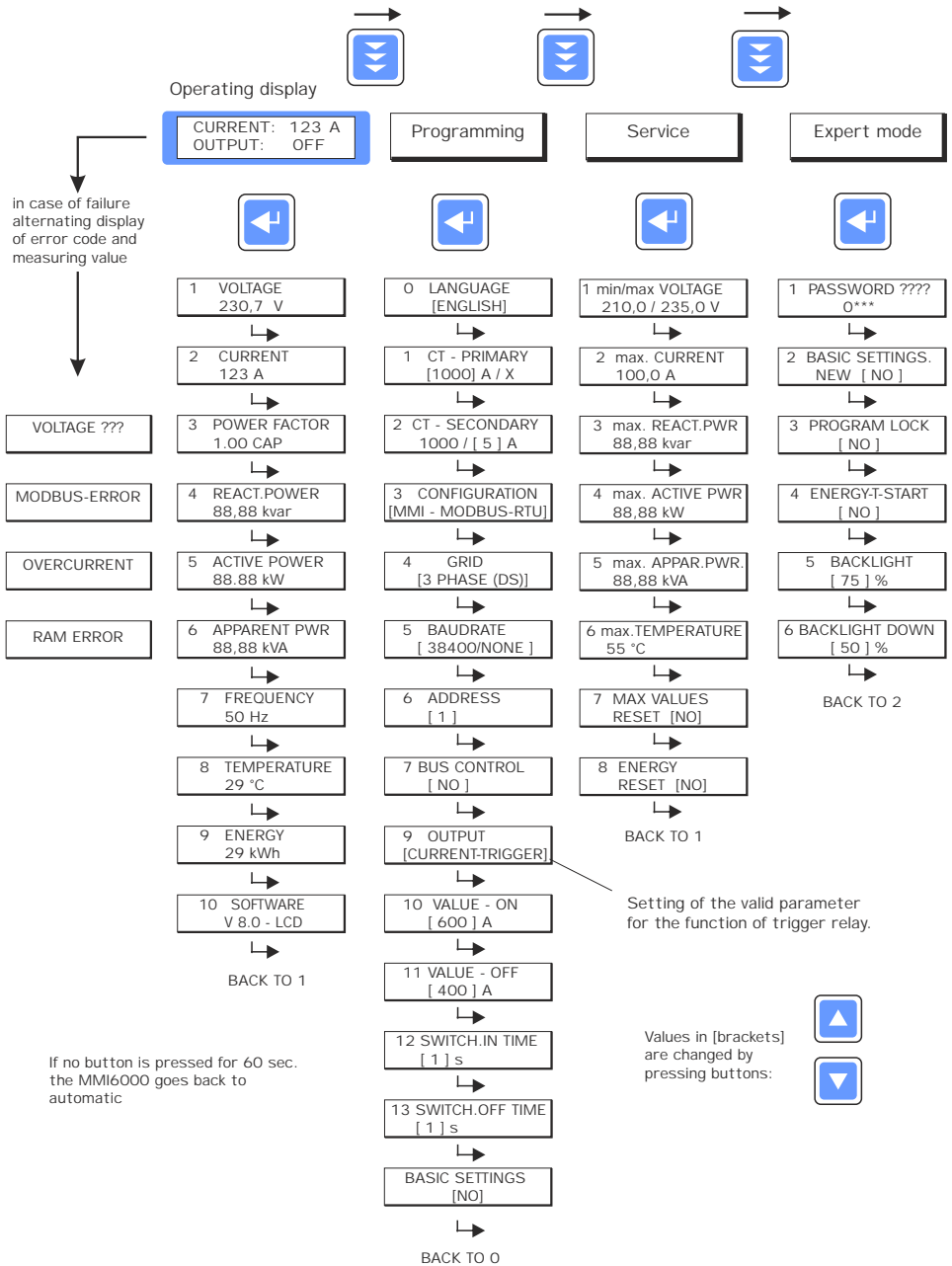
This mode of operation allows the utilization of the MMI6000 as a separate measuring device. Multiple grid parameters (voltage, current, active power, reactive power, apparent power, cos-phi, frequency, temperature, energy) are measured and provided via MODBUS RTU protocol (e.g. further processing by PLC - application of multiple MMI6000 by separate addressing possible). In this mode of operation the MMI6000 can also be used as a comfortable trigger relay for various measuring quantities as for example current, cos-phi, temperature or energy.

Programming of MMI 6000 (setting of operation mode in Programming)

- |    |                          |   |
|----|--------------------------|---|
| 3  | Configuration            | [MMI - MODBUS RTU]  |
| 4  | Grid [3-phase (DS)]      | (alternative: 1-phase (WS) 50/60Hz<br>Standard is to measure using a single current transformer (display is 3-phase assuming grid symmetry). For real single-phase displaying [1-phase (WS)] has to be set. In this case currents and powers are referred to the particular phase.  |
| 5  | BAUDRATE [38000/NONE]    | (9600...256000) NONE/ODD/EVEN<br>RS485 interface baud rate.   |
| 6  | ADDRESS [1]              | (1 ...255)<br>Address range to allow the use of several MMI6000 at the same bus.  |
| 7  | Bus control [NO]         | (alternative: YES)<br>Control of communication. A possible bus error will be display if activated.  |
| 9  | OUTPUT [Current-trigger] | (variants see appendix 1)<br>(current-trigger / current-window / cos-phi-trigger / cos-phi-window / temp.-trigger / temp.-window / bus-error / pulse kWh / Off / energy-trigger)<br>If used as trigger relay this setting determines the relevant parameter for the trigger signal (current, temperature, cos-phi, energy ...)  |
| 10 | VALUE ON* [600] A        | (possible: 5 ... 999 A)<br>Setting of the switching-on threshold - see appendix 2<br>Range and unit of values depends on the parameter selected for measurement.  |
| 11 | VALUE OFF* [400] A       | (possible: 5 ... 999 A)<br>Setting of the switching off threshold - see appendix 2<br>Range and unit of values depend on the parameter selected for measurement.<br>Attention: In case the setting of the switching-off threshold is larger than the switching on-threshold the relay automatically operates as negated switch. |
| 12 | Switch. in time* [1] s   | (possible: 1 ... 255 s)<br>Setting of switching on delay.   |
| 13 | Switch. off time* [1] s  | (possible: 1 ... 255 s)<br>Setting of switching off delay   |

\* Not relevant in case of "Output" set to "output relay - bus error"

# Mode of operation: MMI - MODBUS RTU



Section 9 Mode of operation MMI ASCII -OUT  
and using MMI as trigger-relay

Purpose: MMI6000 as separate measuring device and trigger relay

This mode of operation allows the utilization of the MMI6000 as a separate measuring device. Multiple grid parameters (voltage, current, active power, reactive power, apparent power, cos-phi, frequency, temperature, energy) are measured and displayed. They are also provided as ASCII-data via the RS485 interface (e.g. for display and/or further processing using a common editor software). In this mode of operation the MMI6000 can also be used as a comfortable trigger relay for various measuring quantities as for example current, cos-phi, temperature or energy.

Programming of MMI 6000 (setting of operation mode in programming)

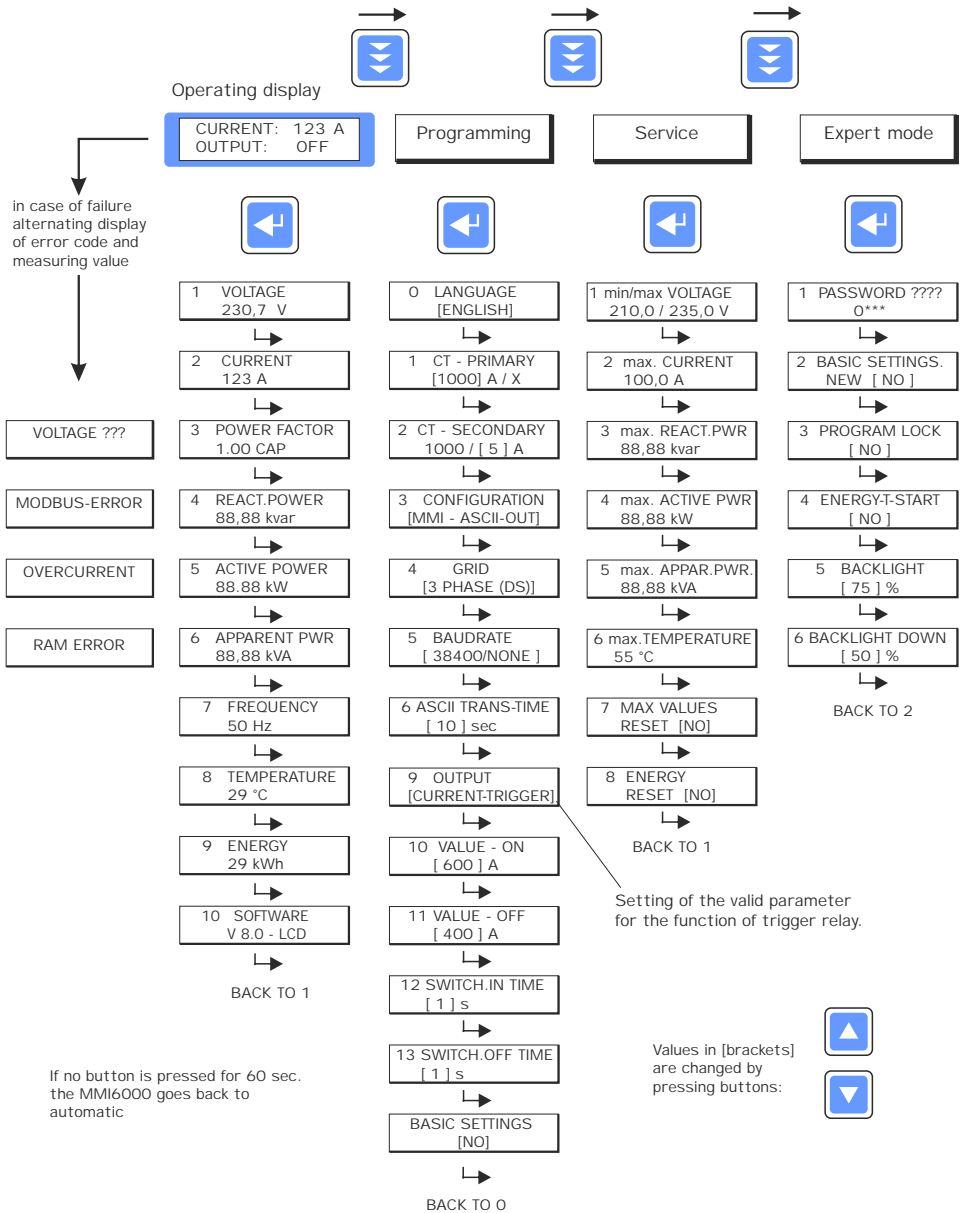
- 3 Configuration [MMI-ASCII OUT]
- 4 Grid [3-phase (DS)] (alternative: 1-phase (WS) 50/60Hz  
Standard is to measure using a single current transformer (display is 3-phase assuming grid symmetry). For real single-phase displaying [1-phase (WS)] has to be set. In this case currents and powers are referred to the particular phase.
- 5 BAUDRATE [38400/ NONE] (9600 ... 256000) NONE/ODD/EVEN
- 8 ASCII submission time [10] s (1 ... 255)  
Time after which the ASCII data submission is cyclically repeated.
- 9 OUTPUT [Current-trigger] (variants see appendix 1)  
(current-trigger / current-window / cos-phi-trigger / cos-phi-window / temp.-trigger / temp.-window / bus-error / pulse kWh / Off / energy-trigger)  
If used as trigger relay this setting determines the relevant parameter for the trigger signal (current, temperature, cos-phi, energy ...)
- 10 VALUE ON\* [600] A (possible: 5 ... 999 A)  
Setting of the switching-on threshold - see appendix 2  
Range and unit of values depends on the parameter selected for measurement.
- 11 VALUE OFF\* [400] A (possible: 5 ... 999 A)  
Setting of the switching off threshold - see appendix 2  
Range and unit of values depend on the parameter selected for measurement.  
Attention: In case the setting of the switching-off threshold is larger than the switching on-threshold the relay automatically operates as negated switch.
- 12 Switch. in time\* [1] s (possible: 1 ... 255 s)  
Setting of switching on delay.
- 13 Switch. off time\* [1] s (possible: 1 ... 255 s)  
Setting of switching off delay

\* Not relevant in case of "Output" set to "output relay - bus error"

Basic settings [NO] (alternative: YES)  
Choosing YES and confirming (Enter) resets all values to the factory settings.



# Mode of operation: MMI - ASCII-OUT



## Section 10: Expert mode

The expert mode is identical for all modes of operation. To protect the provided special functions from misuse or the occasional mistake this level is protected by an access code.

### 1 PASSWORD: 6-3-4-3

After entering this code and after confirming it (Enter) the mentioned special functions are accessible:

### 2 BASIC SETTINGS NEW [NO] (alternative: YES)

Choosing YES and confirming (Enter) will store the present settings as new factory settings. ATTENTION! The original factory setting will be lost!

### 3 PROGRAM LOCK [NO] (alternative: YES)

For protection against unauthorized or accidental change of parameters the device can be locked. If locked, all set parameters can be displayed but are not accessible for changing.

### 4 ENERGY - T- START

This starts the energy-counter for trigger-value „energy-trigger“ manually.

Only possible, if select: „programming/output: energy-trigger“

Not available in mode „DYNA\_T-Trigger“

### 5 BACKLIGHT [75]% (0...100%)

Setting of the brightness of backlight

### 6 BACKLIGHT DOWN [50]% (0...100%)

When the buttons are not used, an automatic will dim the brightness of the backlight to this value.

## Section 11: Maintenance and warranty

Special periodic maintenance of the MMI6000 is not necessary, if the MMI6000 is operated according to the instructions. A regular functional test is recommended however.

In case of misuse and/or manipulation inside the housing of the device any claim of warranty is void.

### Table 1: ASCII protocol

The measured grid parameter values are cyclically submitted at the interface in the following sequence (ASCII):

```
(value voltage) V [CR]
(value current) A [CR]
(value reactive power) kvar [CR]
(value active power) kW [CR]
(value apparent power) kVA [CR]
(value frequency) Hz [CR]
(value temperature) °C [CR]
-----
```

## Appendix 1: Programming of the switching output

The switching output of the MMI6000 (version -R/ -T) is free programmable in all operation modes, except of „Dyna-I-Trigger“

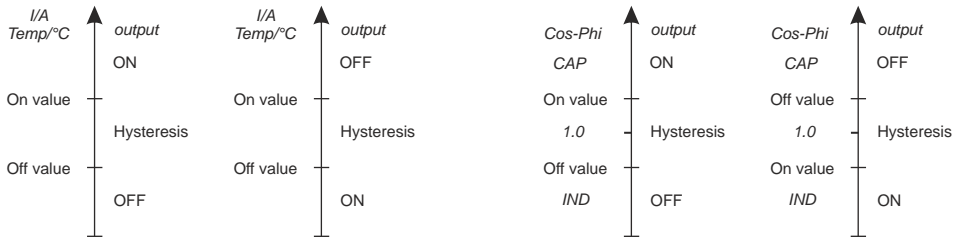
The following variants are possible:

- current-trigger / current window description „trigger“ / „window“ below
- cos-Phi-trigger / cos-Phi-window description „trigger“ / „window“ below
- temp-trigger / temp.-window description „trigger“ / „window“ below
- bus-error relay @ bus-error
- pulse /kWh output 1 pulse /kWh
- without funktion
- energy-trigger:  
function „energy-trigger“ extends the programm-menu with following items for selecting the requested target value.  
Reaching this value will switch the output-relay.

|                                 |               |                        |
|---------------------------------|---------------|------------------------|
| 16 ENERGY-FUNCTION              | [NORMAL]      | (Relay: normal/invers) |
| 17 RANGE -max.                  | [999.9]kWh    | (9...9999) kWh         |
| 18 VALUE DIGIT 1 (target value) | [1]           | (0...9)                |
| 19 VALUE DIGIT 2 (target value) | [1]           | (0...9)                |
| 20 VALUE DIGIT 3 (target value) | [1]           | (0...9)                |
| 21 VALUE DIGIT 4 (target value) | [1]           | (0...9)                |
| 22 START in menu ExpertMode     | (advice only) |                        |

## Appendix 2: Function „Trigger“ resp. „Window“

### Example TRIGGER



### Example Window

